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RABBITS AND GRASSHOPPERS: VECTORS OF ENDOMYCORRHIZAL FUNGI ON NEW COAL MINE SPOIL

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ABSTRACT.— Rabbit droppings and grasshoppers were collected on recently graded coal mine spoil to determine if they were vectors of endomycorrhizal fungi. After 6 weeks of growth, roots of rye grass and sudan grass grown in mixtures of sterilized sand containing either unsterilized rabbit droppings or grasshoppers were endomycorrhizal, while the roots of plants grown in sterilized mixtures of these were not.

KEY WORDS: Mycorrhizae, spoil banks, animal vectors, revegetation, insect vectors.

Coal strip mine operations alter the natural soil strata, producing a mixture of rock fragments, clays, coal fragments, and the original soil. The site condition of this heterogeneous mixture is varied, and commonly referred to as "spoil".

Microflora investigations of plants growing on spoils have shown plants to be infected with vesicular arbuscular (VA) endomycorrhizae. Daft *et al.* (1975) found endomycorrhizae on roots of grasses and other herbaceous plants colonizing anthracite and bituminous coal spoils in Pennsylvania and bituminous coal spoils in Scotland. Marx (1975) reported that grasses, trees, and herbaceous plants on both artificially and naturally revegetated coal spoils in Kentucky and Virginia were endomycorrhizal infected to some degree. Endomycorrhizal fungi are thought to spread slowly— mainly by water, soil movement, and possibly mammals and insects. Recently, Trappe and Maser (1976) found spores of *Glomus macrocarpus* Tul. & Tul. to be viable after passing through the digestive tract of rodents. The purpose of the present study was to determine if the mammals or insects that frequented a recently graded spoil could be vectors of endomycorrhizal fungi.

METHODS

In mid-summer 1978, rabbit droppings and live grasshoppers were randomly collected at the Sahara Coal Mine Company near Carrier Mills, Illinois on a spoil graded in the fall of 1977. (According to the 1971 Illinois Surface-Mined Land Conservation and Reclamation Act, top soil need not be replaced.) The rabbit droppings and grasshoppers were divided into two portions. One portion, along with several containers of builders sand, was sterilized by autoclaving at 122C and 17 psi for two 2-hour periods; the second period was 24 hours after the first. The second portion of the droppings and grasshoppers were dried for 72 hours at 30C in an oven, crushed and mixed separately with autoclaved sand in separate lots. Similarly sterilized rabbit droppings and grasshoppers were crushed and mixed with sterilized sand. Four replications each of rye grass (*Lolium perenne* L.) and sudan grass *(Sorghum sudanense)* were planted in 1-gallon containers with the mixtures. Both a sterilized and unsterilized sand control were also planted. All plants were grown for 6 weeks under greenhouse conditions.

Plant roots were examined for VA endomycorrhizal presence with a compound microscope at 100X

after clearing and staining the roots according to the method of Phillips and Hayman (1970).

RESULTS AND DISCUSSION

Careful examination of plants growing in sterilized sand mixed with either unsterilized rabbit droppings or grasshoppers showed some of them to be endomycorrhizal. As shown in the following tabulation, after 6 weeks of growth, plants were 20 and 31 percent infected when grown in sterilized sand containing unsterilized rabbit droppings, and in sterilized sand and grasshoppers, respectively. Plants grown in sterilized sand containing either sterilized rabbit droppings or sterilized grasshoppers had no infection.

Treatment	Rye grass	Sudan grass
	Percent[1]	
Unsterilized sand	7	8
Sterilized sand	0	0
Sterilized sand + sterilized rabbit droppings	0	0
Sterilized sand + unsterilized rabbit droppings	20	28
Sterilized sand + sterilized grasshoppers	0	0
Sterilized sand + grasshoppers	22	31

Gerdemann and Trappe (1974) found mature *Endogone* spores that had passed through the digestive tracts of mammals without morphological changes. However, no viability tests were done on spores. Taylor, Vorhies, and Lister (1935) state that jack rabbits (*Lepus californicus melanotis*) regularly defecate as they feed, or very soon afterwards. Therefore, it is probable that many fungal propagules could pass through a rabbit's digestive tract unharmed.

Hansen and Ueckert (1970) reported ingestion of fungi by crickets and grasshoppers. According to Gerdemann and Trappe (1974), some of this fungal material was later identified as spores of Endogonaceae.

Although droppings of rodents were not investigated in this study as a means of endomycorrhizal dispersal, rodents such as field mice are known to feed upon a variety of endomycorrhizal fungi (Bakerspigel 1958). Near the study area, 33 mice were trapped in one night using the line transect method (Dennis Harmon, personal communication).

Fumigated nursery soil and other areas treated to preclude micro-organisms may be reinfected by rabbits and grasshoppers or other vectors that feed or come in contact with such fungi. South (1977) states that both inoculated and uninoculated soil that had previously been fumigated with methyl bromide produce seedlings having the same amount of infection.

[1]*Based on 100 plants.*

SUMMARY AND CONCLUSION

Rabbit droppings and live grasshoppers were collected from a recently graded coal mine spoil. A portion of both along with builders sand was sterilized while the remaining portion was not. These were mixed separately with sterilized sand and planted with rye grass and sudan grass. After 6 weeks, a number of roots growing in both the unsterilized rabbit droppings and grasshoppers and sterilized sand mixtures were endomycorrhizal, while the roots of plants in either mixture containing sterilized rabbit droppings and sterilized grasshoppers and sterilized sand were not. Results from this study show that both rabbits and grasshoppers are vectors of endomycorrhizal fungi. Further research is needed to determine how important small mammals and insects such as rabbits and grasshoppers are in the dispersal of endomycorrhizae.

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